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Title:

Structuring food for improving nutrient bioavailability: the case of dairy gels

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The food matrix structure is one of the key drivers to control the fate of food in the digestive tract and, consequently, the kinetics of nutrient release. Milk is a raw material that can be seen as a “Lego box” from which all the constituents can be separated (cracking) and re-assembled into different structures.

The behavior in the gastrointestinal tract of milk protein matrices of identical composition but different micro and macrostructures was investigated in the present study. Six multi-cannulated and catheterized mini-pigs were fed 6 different dairy matrices (raw and heat-treated milks, acid and rennet gels). Effluents from the duodenum and mid-jejunum as well as plasma from the abdominal aorta were collected over 7h. Structure was shown to drive the time of residence of food in the stomach. The liquid-gel transition led to a significant increase in the gastric emptying time. Liquid matrices generated a fast and intense peak of proteins in the intestine and amino acids in the bloodstream. Rennet gels formed a compact coagulum in the stomach that slowed down the gastric emptying and delayed the release of amino acids. A mathematical model of digestion was built from these data.

Therefore, controlling the time of residence of food in the stomach by playing on its structure allows to design products with a fast release of nutrients particularly adapted for elderly whereas foods persisting in the stomach will induce satiety. As an example, 2 isocaloric yogurts with 3.3 and 8.4g of protein /100g respectively were manufactured and given to 11 pigs. Gastric emptying followed by scintigraphy was significantly slowed down for the protein-enriched yogurt leading to different kinetics of proteolysis.

Finally, the mechanisms of gel particle breakdown in the stomach were further investigated using biophysical methods (SAXS, imaging) and some preliminary results will be presented.